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ABSTRACT

This paper reports on the first phase of a research project undertaken by a team at the University of South Australia and Victoria University of Wellington (New Zealand) to design and deliver educational applications of digital learning media and to identify criteria for assessment of the efficacy and quality of the use of such media from a comparative analysis of three credit-bearing courses delivered in both on-line and conventional modes of delivery. The paper examines a set of assumptions derived from a constructivist approach to learning design in the context of a case study of Infotrain, an Internet-based course on electronic publishing. The following design principles for production of educational applications of digital multimedia are outlined: foster critical thinking as well as core skill competencies; create problem-based learning modules; frame problems in learner's life context; non-linear problem sets; essential role of the mentor; making optimal use of digital storage potential; making optimal use of the unique random access characteristics of digital media/hypertext; foster navigation skills and access to the totality of resources available; no preferred solution path; and a guide through the labyrinth. The Infotrain case study and conclusions to be considered in design of new courses incorporating digital media are presented. (Author/DLS)

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Design Considerations in the Development and Delivery of Digital Learning Media

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Abstract: The growing use of the Internet and other digital modes of delivery for higher education challenges universities to identify new criteria for the design, production, and quality assessment of programmes delivered via digital learning media.

This study reports on phase one of a research project undertaken by a team from the University of South Australia and Victoria University of Wellington to design and deliver educational applications of digital learning media, and to identify criteria for assessment of the efficacy and quality of the use of such media from a comparative analysis of three credit-bearing courses delivered in both on-line and conventional modes of delivery.

The paper examines a set of assumptions derived from a constructivist approach to learning design, in the context of a case study of an Internet-based course on electronic publishing, known as "Infotrain", developed at the University of South Australia, by Philip Marriott and Michael Brittain.

CONTEXT OF THE STUDY

Digital learning media is most often encountered either in the form of self-contained courses of instruction on CD-ROM discs or by the presentation of interactive learning programmes on the World Wide Web. In the future, other digital technologies including DVDs (digital video discs), digital satellite transmissions and fibre-optic cable are anticipated to supersede CD-ROMs and the present form of the World Wide Web.

Although courses on a CD-ROM disc and Internet-based programmes engender fundamentally different learning experiences, both of these new modes of educational delivery have provided individual learners worldwide with new patterns of flexibility.

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The focus of this paper is primarily upon Internet-based learning activities. Accordingly, all references to digital learning media herein refer to courses offered on-line which may be supplemented by storage of intellectual property such as textbooks on an associated CD-ROM disc.

This paper is the product of four years of research and experimentation with emerging educational technologies in an effort to identify the most appropriate uses of the digital learning media. One application of this research has been the creation of an Internet-based course on electronic publishing, known as "Infotrain" at the University of South Australia, by Michael Brittain and Philip Marriott. This course, which has be active since 1995, serves as a case study against which theoretical approaches to digital design may be considered in context and evaluated.

FUNDAMENTAL PREMISE

The basic premise underpinning this project is the belief that widespread adoption of digital learning media requires academic staff to completely rethink the nature and practice of higher learning.

The advent of digital learning media profoundly alters the relationship of the learner to his or her university, tutor and course material. The control of when, where and how one learns shifts from the provision of the academic manager to become the primary responsibility of the individual learner.

An extensive literature search was undertaken in order to delineate contemporary views of educationalists of the best practice for the design and delivery of digitally presented learning media.

The main thrust of the design approach advocated in this paper is to shift the teaching process from "subject-based" instruction to "problem-based" learning. The tasks and exercises component challenges students to:

a) Discover what they already know about a subject and attempt to apply that knowledge to find methods of solving similar problems which are likely to arise in their professional and private lives. This orientation meets the design criteria that generic course material be applied, coherent and problem-based.

b) Attempt increasingly difficult tasks supported by hints, model approaches and methodological suggestions (but not "correct" answers).Problems posed will be supported by Socratic instruction (whereby student questions are answered by questions which encourage the student increasingly rely on their own powers of analysis).

CURRENT BEST PRACTICE CRITERIA FOR DIGITAL LEARNING DESIGN

The following ten design principles have been delineated from an extensive literature review should be considered in the production of educational applications of digital multimedia:

Principle 1: Foster Critical Thinking as Well as Core Skill Competencies

Constructivism (a cognitive approach to learning in which the core objective of educational design is to facilitate the development of critical thinking and problem-solving skills) is superior to content-oriented curricula which promotes rote learning. [Clift & Chambers, 1994]

Principle 2: Create Problem-based Learning Modules

Problem-based learning techniques engage learners by posing relevant problems in a context which challenges the learner to discover how to use theoretical concepts within a discipline as practical tools of analysis.

Principle 3: Frame Problems in Learner's Life Context

People learn best when presented with problems which they may reframe to be relevant to their life circumstances, goals and interests.

Principle 4: Non-linear Problem Sets

No single solution path can be deemed correct and will enable the learner to utilise virtually any aspect of the materials available on the CD-ROM (or Internet) in an integrative fashion to synthesise a solution. In solving problems, a learner is encouraged to first subjectively formulate the criteria by which an optimal solution to the given problem may be judged.

Principle 5: The Essential Role of the Mentor

Learning, as with all forms of communication, entails an intersubjective social negotiation of meaning through interpersonal discourse. Accordingly, a mentor-learner relationship is crucial to optimal learning experiences. An application of an non-programmed design approach to learning media design rejects structured non-linear instructional modules, as well as the production of mere linear digital textbooks, in favour of media which present problems without any predetermined solution paths. Such non-structured learning experiences will require the participation of a mentor who can provide cues and Socratic support to the learner as he or she constructs meaning relevant to a specific context or vocation.

Principle 6: Making Optimal Use of Digital Storage Potential

Educational uses of digital multimedia are most effective where the vast storage capacities of the media are used to simulate the array of relevant information pertaining to a discipline which the learner must develop skills at searching and evaluating for use in solving the type of problems typical of the discipline being studied.

Principle 7: Making Optimal Use of the Unique Random Access Characteristics of Digital Media: Hypertext

The digital learning media should be designed such that regardless if it is in a CD-ROM, DVD or World Wide Web format, the learner can readily access from within the programme the unlimited resources of the Internet. Hypertext encourages a decentering process by potentially linking all texts in unmapped and unprogrammable network paths. [Landow & Delany, 1990] It is this attribute which merits close attention in the design of digital multimedia. Hypertext challenges us to comprehend how documents are related. We no longer can experience a book as the authoritative and permanent product of an author. With hypertext, a document is no longer linear or fixed. With hypertext all documents are dynamic and fluid "re-writings" produced by their readers.

Principle 8: Foster Navigation Skills and Access to the Totality of the Resources Available

Learners are empowered to creatively draw upon the totality of the resources available to them in the search for solutions to problems. The learner would then be encouraged to utilise the digital technology only as a starting point to commence the search for the required solution. In this manner, the self-confidence and initiative of the learner would be fostered as would the recognition that all knowledge is dependent upon underlying assumptions.

Principle 9: No Preferred Solution Path

The design of multimedia rejects predetermined non-linear structures for learning materials on CD-ROM or the World Wide Web, as well as linear programming, in favour of media which present problems without any predetermined solution paths. Such an approach to the use of multimedia simulates the unstructured nature

which one often encounters problems in the workplace and every other facet of life. This compels a learner to utilise his or her own judgment in formulating a solution rather than seeking to replicate the solutions proposed by course designers.

It is recommended that where possible, problem sets be presented to voluntary study groups of learners for collaborative problem-solving and mutually supportive learning interactions.

Principle 10: A Guide Through the Labyrinth

Implementation of Principle 9 above serves to promote an unstructured approach to making sense of the world by grasping whole systems, rather than minute analysis of their perceived parts, reinforces the central role of the mentor in the learning process. Without an interactive guide, an "unstructured wholeness" approach to the presentation of problem-based learning modules could leave a learner submerged in his or her options in a labyrinth of information.

A theoretical rationale for the indispensability of the interpersonal interaction between a mentor and a learner, in an optimal learning experience, can be found in the work of the social constructionists who contend that all perceptions of reality (including learning) are constructed from discourse and negotiation.

Biocca [Biocca and Levy, eds. 1995] has theorised about the social construction of a learning experience embedded within the design of the course materials. Each educational technology entails the communication of a discourse that influences how learners think about reality. The pre-programmed, self-contained course material frequently encountered on CD-ROM and many Internet-based courses are not able to simulate a dialogue that will meet the learning needs of any individual learner. This requires personal interaction from an intelligent and perceptive mentor. Accordingly, an optimal learning strategy recognises the essential role of human interaction whose support of the learner facilitates a constructive dialogue as the learner constructs meaning from the educational experience.

Educational multimedia may supplement a learning experience by presenting a powerful simulation of a particular facet of the external world. However, what digital multimedia commonly lacks is the ability to interact dynamically and intelligently in a discourse with every learner about what such a simulation means.

The provision of a dialogue is the role of the human mentor that facilitates and manages the learning experience of an individual acquiring the cognitive and domain skills of a discipline. Again what is sought is not the acquisition of specific content knowledge but rather the growing sophistication of a learner in addressing problems typical of a discipline by using theories and concepts as tools of analysis. This process of development in a person's cognitive reasoning capacities is best facilitated by a dialogue with an accomplished mentor. Until machines are capable of fully simulating the cognitive and social repertoire of humans, the role of a mentor will continue to be an irreducible element of an optimal higher learning experience. The mentor fades from the learner's endeavours as he or she becomes more confident and self-reliant.

THE "INFOTRAIN" CASE STUDY

Infotrain [Marriott and Brittain, 1995a, 1995b] was developed in the period 1995-1996 at a cost of approximately A$50,000. Upon opening the course for enrolment in 1996, Infotrain attracted 50 students. Soon, the course generated hundreds of emails each week as learners gained competence at interacting on the Internet with their tutors and "classmates". In 1997 approximately 97 students are enrolled, across a wide range of disciplines. The project team has analysed the Infotrain experience from the perspective of three stages:

a) Trialling

b) Learner feedback

c) Reflection by course managers based on 3 years' experience of delivery

Feedback from Infotrain students suggests that they tend to fall into one of two groups: those who drop out of conventional classroom lectures and rapidly rely solely on the Web-based course materials to complete their studies, and approximately 30% of the students who require continuing contact to achieve learning objectives. It is recognised that for many students the social aspects of the learning experience are a vital component and for these students non-verbal communication elements within the classroom context are as important as the expressed verbal content. Other factors appear to be a need for some to enjoy the "theatre of the lecture hall", the presence of a mentor to help the learner impose personal discipline to performing one's learning tasks as well as a guide to suggest pathways through the labyrinth of information confronting students on-line.

Underpinning the Infotrain initiative is a desire to create a flexible and efficient learning environment. As Infotrain has matured since 1995, each iteration of the course has made a closer approach to this goal. Students may take the course in a structured teacher-centred, lecture-tutorial way, or a student-centred, internet-based, distance manner. They can also move backwards and forwards between these two options as they wish - attending lectures and tutorials for a few weeks before changing to an online approach. The same materials are used in lectures and online. Students can work in groups or as individuals. Ideally we would like students to have the opportunity to determine their rate of progress through the course - however the present constraints of assessment timelines and staff workloads have not made this workable.

The ability to rapidly apply the results of student feedback has enabled the fast development of the online materials. We are presently looking at a means of easily localising content. The intention is to target the Infotrain materials to specific client groups. In 1998 Infotrain will offered at the University of South Australia and Victoria University of Wellington. A cut-down version of Infotrain to be delivered by CD is under development for the general public.

CONCLUSIONS

The authors have derived the following preliminary conclusions to be considered in Phase II design of new courses incorporating digital media:

a) Digital learning media has the potential to transform the very concept of the traditional university by deploying distributed expertise and altering resource requirements for the provision of quality learning experiences. Infotrain has demonstrated that there is a new role emerging for tutors which necessitate a redefinition of how a University must commit scarce time and teaching resources. This emerging mode of delivery raises the prospect that international networks of tutors may emerge to collaborate on courses offered simultaneously at several institutions throughout the world.

b) These transformations will require academic staff to develop new qualifications, skills and tutoring methods. Of primary importance for academics will be the acquisition of excellent navigational and searching skills and the ability to transmit those capabilities to one's learners.

c) Current best practice is served by cognitive and constructivist approaches to course design. Digital learning media should be to foster critical thinking skills as well as generic competencies. Learners should be encouraged to use content-specific principles as tools of analysis rather that required to replicate course content.

d) A substantial percentage of learners require continuous interpersonal contact to achieve satisfactory learning outcomes. It is urged that the regular synchronous or asynchronous participation of a mentor be regarded as an indispensable element of the learning process.

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